

Remarks

Entry of the amendments presented, reconsideration of the application and allowance of all pending claims are respectfully requested. Claims 1-14 and 30-33 remain pending.

In accordance with 37 C.F.R. 1.121(c)(1)(ii), a marked-up version of the amended claims is provided on one or more pages separate from the amendment. These pages are appended at the end of the Response.

By this paper, claim 1 is amended to more particularly point out and distinctly claim the subject matter of the present invention. This amendment to claim 1 is responsive to the 35 U.S.C. §112, second paragraph, rejection of claims 1-14 stated in the final Office Action. As amended, claim 1 recites that the first solder bumps and second solder bumps offset between the first substrate and the second substrate are separate sets of solder bumps. Based upon this amendment, withdrawal of the 35 U.S.C. §112, second paragraph, rejection to claims 1-14 is respectfully requested. No new matter is added to the application by any amendment presented herewith, and the amendments presented do not necessitate a further search by the Examiner.

Substantively, claims 1-13 and 31-33 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ju et al. (U.S. Patent No. 5,497,258) in view of Dalal et al. (U.S. Patent No. 5,796,591), while claim 14 was rejected under 35 U.S.C. §103(a) as being unpatentable over Ju et al. and Dalal et al. as applied to claims 1 and 11 above, and further in view of Degani et al. (U.S. Patent No. 5,646,828). These rejections are respectfully, but most strenuously, traversed and reconsideration thereof is requested. This paper represents applicants' first opportunity to comment on the new combination of art applied in the final Office Action.

First, applicants respectfully traverse the combination proposed in the Office Action to the extent that the Office Action alleges that the combination suggests the claimed invention. The only justification given for the Examiner's proposed combination of Dalal et al. with Ju et al. is to "increase the yield and have a joint that has high reliability as taught by Dalal et al. in column 4, lines 53 and 54." Applicants respectfully submit that this justification does not

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identify an adequate teaching, suggestion or incentive in the art itself to combine these references in the manner set forth in the Office Action. There is absolutely no justification given in the Office Action or cited in the art itself why one of ordinary skill in the art would selectively apply the teachings of Dalal et al. to only one set of solder bumps depicted by Ju et al.

Applicants respectfully submit that the only suggestion or incentive for combining the two teachings in the manner set forth in the Office Action is presented in applicants' own disclosure, which as well known, cannot be used as a reference against him. The consistent criterion for determination of obviousness is whether the prior art would have suggested to one of ordinary skill in the art that the claimed device would have a reasonable likelihood of success, viewed in light of the prior art. Both the suggestion and expectation of success must be found in the prior art, not in applicants' disclosure. In this case, the basis for selective combination of Dalal et al. with one set of bumps of Ju et al. is drawn from applicants' own disclosure, in violation of this principle.

Moreover, neither Ju et al. nor Dalal et al. discusses the problem addressed by the present invention, i.e., how to achieve better alignment of fine pitched solder bumps. As cited in the Office Action, Dalal et al. is addressing increasing yield and having a joint with higher reliability. This is achieved in Dalal et al. by providing solder bumps 38 with tin caps 41 to achieve better electrical connection to copper pads 20.

Even assuming, arguendo, that the combination is proper as set forth in the Office Action, the combination still fails to teach or suggest features of the invention. For example, the independent claims recite first solder bumps and second solder bumps offset between, for example, the first substrate and the second substrate (see claim 1). These first solder bumps and second solder bumps are separate sets of solder bumps disposed between the first substrate and the second substrate. The second solder bumps have at least a portion that melts at a lower temperature than the first solder bumps. In applicants' structure, there is a melting temperature difference between a first set of solder bumps and a second set of solder bumps. This concept is simply missing from Ju et al. and Dalal et al., either alone or in combination.

Ju et al. teaches a structure having a first set of solder bumps (25 or 36/25) and a second set of solder bumps (26 or 36/26) offset between a first and second substrate. A careful reading of Ju et al. fails to uncover any teaching, suggestion or implication that the different sets of solder bumps have different melting temperatures. For an alleged teaching of this concept, the Office Action relies upon Dalal et al.

Dalal et al. describes a direct chip attached circuit card wherein an IC chip 30 includes a solder bump 38 with a cap of low melting point metal 41 (e.g., tin). Solder bump 38 aligns over and connects to a copper pad 20 disposed above a laminate 10. The Office Action relies upon the mischaracterization of copper pad 20 as a solder bump for an alleged teaching of two sets of solder bumps with different melting temperatures. This mischaracterization is respectfully traversed and reconsideration is requested.

The copper pad 20 in Dalal et al. is simply adjoining metallurgy to which solder is to be connected to. One skilled in the art would not read the teachings thereof as somehow suggesting that copper pad 20 is a solder bump. The phrase "solder bump" refers to a particular metallurgy, which is clearly distinct from copper pads or copper lines on the adjoining structure. Thermal cycling is employed to melt a solder bump and electrically interconnect two structures. Copper pads do not melt during this thermal cycling. In fact, it would be impossible for Dalal et al. to melt copper pads 20, since the organic laminate on which the pads are disposed would be destroyed as well as any other copper lines which may be present. Thus, applicants strenuously traverse the characterization of copper pad 20 as a "solder bump" having a higher melting temperature than the solder bump 38 in Dalal et al.

A careful reading of both Ju et al. and Dalal et al. fails to uncover any teaching, suggestion or implication to one of ordinary skill in the art of two different sets of solder bumps, with one set of solder bumps having a melting temperature that is different from the other set of solder bumps. In view of this omission in the applied art, applicants respectfully request reconsideration and withdrawal of the obviousness rejection to the independent claims presented

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based thereon. If Dalal et al. were to be combined with Ju et al., then one of ordinary skill in the art would combine the solder bump cap presented therein on all of the solder bumps (25 or 36/25) and (26 or 36/26), and not just on one set of solder bumps as suggested in the Office Action. There is simply no suggestion in the applied art to use Dalal et al. on only one set of solder bumps, and not the other set of solder bumps.

Moreover, neither Ju et al. nor Dalal et al. are differentiating between sets of solder bumps and applying a different melting temperature to the two different sets in order to achieve enhanced alignment as recited, for example, in applicants' claim 8. A careful review of column 5, lines 32-34 and FIGS. 8A-8C of Ju et al. fails to uncover any teaching, suggestion or implication of this concept. The alignment reflow discussed by Ju et al. occurs concurrently across all solder joints. There is no differentiation in Ju et al. between the first and second solder bumps having different melting temperatures, nor of such a concept being used to facilitate alignment of one set of solder bumps, i.e., the liner array set of solder bumps. Claim 8 specifically recites that the second set of solder bumps are for aligning the first and second substrate before melting the first set of solder bumps. There is no suggestion in Ju et al. that the first set of solder bumps would not melt at the same time as the second set of solder bumps. Therefore, applicants respectfully request reconsideration and allowance of claim 8.

Claim 10 further states that the second solder bumps melt at a temperature at least 25°C less than that of the first solder bumps. This claim is submitted as a characterization on the second solder bumps melting at a "lower temperature" than the first solder bumps. A careful review of FIG. 5 and column 8, lines 49-57 of Dalal et al. (cited in the Office Action), fails to uncover any relevant discussion to the claimed subject matter. The Office Action again characterizes the copper pads 20 in Dalal et al. as somehow comprising a second set of solder bumps as recited by applicants. This characterization is erroneous. Copper pads represent a completely different metallurgy than solder bumps, and are not relevant to applicants' claimed subject matter. The characterization "solder" is a well know metallurgy to those skilled in the art, and copper does not comprise solder as the term is understood.

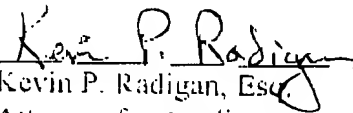
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For all the above reasons, applicants respectfully submit that all claims presented herewith patentably distinguish over Ju et al. in view of Dalal et al. Reconsideration and withdrawal of the obviousness rejection is therefore respectfully requested. The remaining dependent claims are believed allowable for the same reasons as the independent claims (i.e., claims 1 and 30), as well as for their own additional characterizations.

Applicants respectfully request reconsideration and withdrawal of the obviousness rejections contained in the final Office Action.

Applicants' undersigned attorney is available should the Examiner wish to discuss this application further.

Respectfully submitted,


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Marked-Up Version of ClaimsIn the Claims:

Please amend claim 1 as follows:

1. (Twice Amended) A structure comprising:

a first substrate and a second substrate; and

first solder bumps and second solder bumps offset therebetween, wherein said first solder bumps and said second solder bumps are [comprise] separate sets of solder bumps disposed between said first substrate and said second substrate, and wherein said second solder bumps have at least a portion that melts at a lower temperature than said first solder bumps.